

**ENHANCING THE NUMERACY SKILLS OF GRADE 4 PUPILS THROUGH
THE USE OF SUDOMATH GAME BASED APPROACH**

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The Faculty of the College of Education
Misamis University
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In Partial Fulfillment
of the Requirements for the Degree
Bachelor of Elementary Education
Major in General Education

by

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May 2026

APPROVAL SHEET

This thesis, entitled “**ENHANCING THE NUMERACY SKILLS OF GRADE 4 PUPILS THROUGH THE USE OF SUDOMATH GAME BASED APPROACH,**”

prepared and submitted by **JOY LYN C. MUTIA**, in partial fulfillment of the requirements for the degree of **Bachelor of Elementary Education**, has been examined and is recommended for acceptance for Oral Examination.

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DEDICATION

I, the researcher, humbly dedicate this academic work:

To my beloved parents, who have been my greatest source of strength, love, and
inspiration throughout my journey;

To my family and loved ones, for their unwavering support, patience, and encouragement
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ABSTRACT

This study aimed to determine the effect of the SudoMath Game-Based Learning Approach on the numeracy skills of Grade 4 pupils at a selected elementary school in Ozamiz City during the School Year 2025–2026. A classroom-based action research design using a single-group pretest–posttest approach was employed. The respondents of the study consisted of forty-two (42) Grade 4 pupils selected through purposive sampling. Data were collected using a researcher-made Numeracy Skills Test administered before and after the implementation of the SudoMath Game-Based Learning Approach. The research instrument was validated by education experts and tested for reliability, yielding an acceptable Cronbach’s alpha value. Data were analyzed using mean, standard deviation, and paired t-test through Jamovi. Findings revealed that the numeracy skills of Grade 4 pupils before the implementation of the intervention were categorized as Did Not Meet Expectations, while after the implementation, pupils’ performance improved to the Satisfactory level. Statistical analysis further revealed a very highly significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath Game-Based Learning Approach. The study concluded that the SudoMath Game-Based Learning Approach is an effective instructional strategy in enhancing the numeracy skills of Grade 4 pupils through interactive and engaging mathematical activities.

Keywords: *Mathematics Education, SudoMath Game-Based Learning Approach, numeracy skills, game-based learning, Grade 4 pupils, mathematics performance*

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Chapter 1

INTRODUCTION

Context and Rationale

Mathematics is considered one of the fundamental subjects in basic education since it builds the learner's logical reasoning, analytical skills, and problem-solving abilities. Many Grade 4 pupils are still having difficulty mastering basic numeracy skills such as addition, subtraction, multiplication, and division. These difficulties often result in poor academic performance and diminished confidence to learn the subject. Numeracy among elementary learners is one of the central goals of mathematics education in the 21st century. The term numeracy generally refers to the capacity to apply knowledge of mathematics in a variety of contexts. Numeracy is an important element of academic success and life competence. Recent research, however, revealed that a large number of students still struggle with number sense and problem-solving and basic arithmetic operations, which is reflected in their general achievement in mathematics (Rahayu et al., 2025). Schools are increasingly adopting digital and active learning environments, and thus have found it necessary to implement up-to-date strategies such as GBL to maintain student motivation and enhance the understanding of mathematical concepts as necessary (Cayang & Ursabia, 2024).

Numeracy skills are foundational in primary education, equipping learners with the ability to understand and apply mathematical concepts essential for both daily life and academic success. However, many Grade 4 pupils continue to face challenges in mastering numeracy, which can negatively affect their overall mathematical proficiency and future

academic performance (Rahayu et al., 2025). In typical classroom settings, teachers often struggle to engage students who find traditional mathematics instruction uninteresting or difficult, especially in critical areas such as number operations and logical reasoning (Hui & Mahmud, 2023). To address these challenges, innovative instructional approaches like game-based learning (GBL) have gained prominence due to their potential to enhance student engagement and develop cognitive skills by integrating learning with interactive, enjoyable activities (Liang & Sitthiworachart, 2023).

Game-Based Learning has been identified as an effective tool in enhancing students' engagement and academic achievement by transforming traditional learning into an interactive and enjoyable experience. According to (Hui and Mahmud,2023), GBL positively influences both cognitive and affective domains by improving students' mathematical knowledge, motivation, and attitude toward learning. Similarly, (Ergül and Dogan,2022) found that using game-based approaches in teaching mathematical concepts such as place value helps pupils develop deeper conceptual understanding compared to conventional teaching. (Liang and Sitthiworachart, 2023) further assert that GBL provides opportunities for logical reasoning and creative problem-solving, which are vital for developing numeracy literacy among primary learners.

In the context of numeracy, game-based approaches allow pupils to visualize mathematical relationships, recognize patterns, and apply mathematical reasoning in problem-solving situations. As (Lee and Choi, 2020) emphasize, math games can significantly enhance early numeracy by promoting continuous engagement and facilitating conceptual mastery. Likewise, (Singh et al. 2021) developed “Math Zap,” a card game that effectively improved students' numeracy performance and mental

computation. These studies suggest that integrating digital or physical games in math classrooms nurtures not only basic skills but also higher-order thinking, which is essential in building mathematical confidence and fluency (Lamrani & Abdelwahed, 2020).

Despite the growing recognition of GBL's benefits, many classrooms continue to rely on conventional teaching methods that inadequately address students' diverse learning needs and preferences. As a result, numeracy deficits remain prevalent, often linked to low student motivation and limited exposure to stimulating and interactive learning strategies (Abbacan et al., 2025). Grade 4 pupils particularly require engaging tools that support both their cognitive development and affective domains such as motivation and interest (Dan et al., 2024). One promising instructional tool is the SudoMath game-based approach, which employs Sudoku-like puzzles designed to enhance essential skills like pattern recognition and logical reasoning, both crucial for numeracy development (Tengah, 2020). However, despite the potential of SudoMath and similar game-based interventions, studies exploring their effectiveness in the Philippine elementary education context remain sparse.

Empirical research consistently demonstrates that game-based learning interventions significantly improve numeracy skills by promoting active participation and adaptive thinking among learners (Cayang & Ursabia, 2024). For instance, (Lee and Choi, 2020) found that tablet-based math games increased early numeracy proficiency among rural primary students. In a similar vein, (Rahayu et al., 2025) reported that digital game-based learning boosted numeracy literacy and learner motivation in elementary education settings. Furthermore, SudoMath puzzles have been shown to foster pattern discovery and enhance logical thinking, directly supporting mathematical achievement (Tengah, 2020). Nevertheless, despite these promising outcomes, a notable gap exists regarding the

contextualized application and measured impact of such game-based learning strategies on Grade 4 pupils.

While international studies have extensively examined game-based learning's role in enhancing numeracy, there remains a scarcity of localized research that evaluates the specific integration and impact of the SudoMath game-based approach on elementary mathematics teaching in the Philippines. Most prior investigations focus on broader digital game formats or traditional game designs rather than puzzle-based games crafted to develop logical reasoning and pattern recognition, which are essential cognitive skills underpinning numeracy (Ergül & Dogan, 2022). Importantly, (Miles, 2017) highlights a critical gap in understanding how innovative educational interventions translate into practical classroom outcomes, emphasizing the need for research situated within authentic learning environments. This research gap underscores the necessity to investigate SudoMath's effectiveness in enhancing numeracy skills among Grade 4 learners, including its influence on learner engagement and motivation.

The purpose of this study is to investigate the effectiveness of the SudoMath game-based learning approach in enhancing the numeracy skills of Grade 4 pupils within the Philippine elementary education setting. This study aims to assess how the integration of SudoMath puzzles impacts students' mathematical proficiency, focusing on critical areas such as pattern recognition, logical reasoning, and number operations. Additionally, the research seeks to explore the influence of the SudoMath approach on learners' engagement, motivation, and interest in mathematics. The study also intends to identify the challenges and opportunities experienced by both teachers and students in implementing this game-based strategy in the classroom. Ultimately, the findings aim to provide evidence-based

recommendations for educators and curriculum developers, supporting the integration of innovative game-based learning methods that can improve numeracy outcomes and foster a more positive attitude toward mathematics among elementary learners.

This study aims to provide empirical evidence on the effectiveness of the SudoMath game-based approach in enhancing numeracy skills among Grade 4 pupils. Addressing numeracy challenges at this stage is pivotal for establishing a strong mathematical foundation that supports academic success and lifelong learning (Sari et al., 2025). Additionally, by integrating an innovative and interactive game-based learning tool, educators may foster increased motivation, interest, and cognitive engagement in mathematics, thereby mitigating issues related to student disengagement and math anxiety (Hidayat et al., 2024). The findings from this study will provide valuable insights for teachers, curriculum developers, and policymakers, facilitating the adoption of Sudoku-inspired games as an effective instructional strategy in primary education.

The SudoMath game-based approach is a carefully designed learning intervention that adapts Sudoku puzzles to the developmental level of Grade 4 pupils, aiming to improve numeracy through problem-solving and pattern recognition tasks (Tengah, 2011; Jinon, n.d.). This approach capitalizes on the inherent interactivity and engagement of game-based learning, which research has shown to enhance not only mathematical skills but also students' cognitive and affective domains, including motivation, interest, and academic achievement (Hui & Mahmud, 2023; Dan et al., 2024). By blending conventional mathematics instruction with the dynamic challenge of SudoMath puzzles, this study seeks to create a more stimulating and effective learning environment that promotes mathematical reasoning, accuracy, and student confidence in numeracy.

The SudoMath Game-Based Approach is an instructional strategy that integrates mathematical concepts into an interactive and engaging game format, designed to enhance numeracy skills among Grade 4 pupils. This approach aims to make learning mathematics enjoyable and meaningful by incorporating problem-solving and critical thinking within a game context. Pupils actively participate in the learning process by solving puzzles and challenges that require application of numeracy concepts such as addition, subtraction, multiplication, and division.

SudoMath encourages students to think logically, strategize, and collaborate while working through progressively challenging tasks. This game-based learning method supports diverse learning styles and motivates pupils by combining fun and education, fostering a positive attitude towards mathematics. Research indicates that game-based learning improves student engagement, conceptual understanding, and academic performance in mathematics (Sari et al., 2025). According to (Johnson and Lee, 2024), educational games provide immediate feedback, which helps learners correct mistakes and reinforce learning. Furthermore, Gamal et al. (2025) found that integrating games in math instruction promotes sustained attention and increases retention of concepts among elementary pupils. The SudoMath approach aligns with constructivist learning principles, where learners build knowledge through active exploration and problem-solving within a supportive environment. Implementing the SudoMath game-based approach creates an interactive classroom atmosphere that enhances motivation and practical application of numeracy skills. This strategy is particularly effective for Grade 4 pupils as it addresses common difficulties in understanding abstract mathematical concepts by presenting them

in tangible, game-related scenarios. Through consistent use, it is expected that pupils will not only improve their numeracy skills but also develop a lifelong interest in mathematics.

Implementing the SudoMath game-based learning approach begins with the teacher preparing thoroughly by understanding the game's objectives, rules, and how it aligns with the targeted numeracy skills. The teacher must gather all necessary materials, whether physical game boards or digital devices, and plan lessons that incorporate the game in a way that supports curriculum goals. Clear learning objectives should be communicated to the students so they know what skills they are expected to develop through this interactive method.

The teacher then introduces the SudoMath game to the pupils, explaining its relevance to mathematics and demonstrating how to play. Ensuring that the pupils grasp the instructions and game mechanics is crucial before moving forward. The class is organized into small groups or pairs to encourage cooperative learning, allowing students to discuss and solve problems together, which promotes communication and teamwork while reinforcing mathematical thinking. During the gameplay, the teacher plays a facilitative role, circulating among groups to provide support, clarify doubts, and stimulate higher-order thinking by asking probing questions. Immediate feedback is given to help learners reflect on their reasoning and correct mistakes, enhancing their understanding. Following the activity, the teacher leads a group discussion where pupils share their strategies, challenges, and lessons learned, fostering reflection and reinforcing the numeracy concepts practiced. Assessment of learning is conducted through formative tools such as quizzes or observations to measure progress compared to initial skill levels. Pupils' feedback on their experience with the game is also collected to evaluate its impact on their

motivation and engagement. To maximize benefits, the SudoMath game is incorporated regularly over several lessons, gradually increasing in complexity to match pupils' advancing abilities. This method complements traditional instruction and creates a dynamic, motivating learning environment for numeracy skill development.

Statement of the Problem

This study aims to determine the effect of the SudoMath game-based learning approach on the numeracy skills of Grade 4 pupils during the School Year 2025–2026 in Ozamiz City Central School. Specifically, it sought to answer the following questions:

1. What is the level of numeracy skills of Grade 4 pupils before the implementation of the SudoMath game-based learning approach?
2. What is the level of numeracy skills of Grade 4 pupils after the implementation of the SudoMath game-based learning approach?
3. Is there a significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath game-based learning approach?

Null Hypotheses

H01: There is no significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath game-based learning approach.

Chapter 2

Research Methodology

Research Design

This study will employ a classroom base action research approach using single pretest-posttest design. The pretest-posttest design is widely recognized in educational research for assessing the impact of an intervention by measuring learners' skills before and after implementation (Amalia et al, 2024). It enables the researcher to determine whether the game-based approach leads to significant improvements in numeracy mastery and engagement. This design is practical in classroom settings where control groups are difficult to establish, and it effectively captures changes within the same group over a set period (Dan et al., 2024). Digital and game-based learning interventions have shown positive effects on students' motivation and mathematical performance (Hui & Mahmud, 2023), supporting its use for evaluating SudoMath. By comparing pretest and posttest results, the study aims to show the game's contribution to improving both cognitive and affective domains in mathematics education.

Research Setting

This will be conducted in one of a public elementary school located in Ozamiz City, Misamis Occidental, Philippines. A single section of Grade 4 pupils from various cultural, socioeconomic, and linguistic backgrounds, reflecting the community it serves. The Grade 4 level was specifically chosen as the focus group due to the critical importance of developing strong numeracy skills at this stage, which are foundational for future mathematical learning. The school's supportive environment and access to technological

resources provided a conducive setting for implementing the SudoMath game-based learning intervention and assessing its impact on pupils' numeracy skills.

Respondents of the Study

This study will involve 42 Grade 4 pupils enrolled in a public elementary school in Ozamiz City, Misamis Occidental, Philippines, for the school year 2025–2026. The participants will be selected using purposive sampling to ensure that they are currently active Grade 4 students and willing to participate in the study. The criteria for selection include enrollment in Grade 4 at Ozamiz City Central School during the specified school year (2025-2026) and readiness to engage in the SudoMath game-based learning intervention. Only pupils whose parents or guardians consent to their participation will be included, ensuring adherence to ethical research standards. This selection aims to address the gap in research on the effectiveness of Sodumath Game base Approach as a formative assessment tool in improving young learners' focus, understanding, and numeracy skills. By focusing on this group, the study provides insights into how Sodumath activities can enhance meaningful learning in Grade 4 Mathematics.

Research Instruments

The study will use the following questionnaire as a data gathering instrument:

A. SudoMath Numeracy Skills Assessment Test (Appendix A). This researcher-designed test was developed to evaluate Grade 4 pupils' mastery and problem-solving skills in numeracy concepts before and after the implementation of the SudoMath game-based learning approach. The test was created based on previous studies emphasizing the effectiveness of game-based learning in improving students' mathematical reasoning,

engagement, and practical problem-solving abilities (Ergül & Doğan, 2022). It consists of 40 items structured around real-life mathematical problem scenarios, aligned with SudoMath gameplay activities conducted over four sessions spanning four weeks. Each session will last 60 minutes, including a 10-minute pretest, a 40-minute gameplay and instructional activity, and a 10-minute posttest. The test measures problem-solving performance through numerical operations, logical reasoning, and the application of numeracy concepts within meaningful contexts.

To assess pupils' mastery and problem-solving skills, the study will use a 5-point Likert scale, where 5 represents the highest level of proficiency and 1 the lowest:

Scores	Remarks
38-40	Outstanding
35-37	Very Satisfactory
32-34	Satisfactory
29-31	Fair
1-28	Poor

The validity and reliability of the SudoMath Numeracy Skills Assessment Test were established through expert consultations and pilot testing. Mathematics educators reviewed the test content to ensure alignment with Grade 4 competencies in numeracy and problem-solving skills. A pilot study was conducted to assess clarity, coherence, and difficulty level, and Cronbach's alpha was used to measure internal consistency. Prior research confirms that assessments designed around game-based learning effectively enhance students' numeracy skills and engagement by connecting learning to real-world scenarios (Dan et al., 2024; Liang & Sitthiworachart, 2023).

B. Student Engagement and Motivation Questionnaire (Appendix B). This researcher-made questionnaire was designed to assess pupils' engagement and motivation in the SudoMath game-based learning environment. The instrument uses a 5-point Likert

scale, with responses ranging from Strongly Disagree (1) to Strongly Agree (5), adapted from Song et al. (2025). It comprises 20 items categorized into four key constructs: Cognitive Engagement (5 items), Affective Engagement (5 items), Behavioral Engagement (5 items), and Motivation (5 items). These constructs evaluate how pupils interact with the game-based activities, their enthusiasm for learning numeracy, and their persistence in problem-solving tasks. This questionnaire is highly relevant to the study as it measures the impact of the SudoMath game on pupils' motivation and participation.

The instrument will be administered as both a pre-assessment before the intervention and a post-assessment after all gameplay sessions to allow comparative analysis of changes in pupil engagement and motivation. Previous studies show that game-based learning positively influences student collaboration, enthusiasm, and willingness to engage with challenging numeracy tasks (Rahayu & Firdaus, 2025).

The validity and reliability of this questionnaire were established through expert reviews and pilot testing with Grade 4 pupils. Mathematics educators assessed the questionnaire items for alignment with curricular goals and game-based learning objectives. Cronbach's alpha was used to confirm internal consistency, supporting the questionnaire's effectiveness in capturing cognitive, affective, and behavioral dimensions of student engagement and motivation (Rahayu & Firdaus, 2025).

Responses	Continuum	Interpretation
5 – Strongly Agree	4.20-5.00	Extremely High
4 – Agree	3.40-4.19	High
3 – Neutral	2.60-3.39	Moderate
2 – Disagree	1.80-2.59	Low
1 – Strongly Disagree	1.00-1.79	Extremely Low

C. Lesson Plan (Appendix C). In this study, the SudoMath game-based approach is integrated into the Grade 4 mathematics curriculum focusing on numeracy skills such as number operations, pattern recognition, and logical thinking. Each of the four sessions begins with a pretest to assess pupils' initial numeracy mastery, followed by a teacher-facilitated SudoMath gameplay activity where pupils collaboratively solve math problems embedded in the game. For example, pupils will work on pattern puzzles, number placement, and logical reasoning tasks designed to enhance numeracy concepts. After the gameplay activities, a posttest will be administered to evaluate learning gains and the impact of the SudoMath approach on pupils' mastery and problem-solving skills. Comparing pretest and posttest scores will provide data to assess the effectiveness of the intervention in improving numeracy understanding, critical thinking, and the practical application of math concepts in everyday situations (Lozano et al., 2023).

Data Collection

Before conducting the study, the researcher will seek formal approval to conduct the study by submitting letters to the appropriate school authorities. Approval will first be sought from the Misamis University Research Ethics Board (MUREB) to ensure compliance with institutional and ethical research standards. A formal letter will then address to the Dean of the College of Education at Misamis University. Upon approval, the researcher will secure endorsement from the Program Head, followed by the submission of a request letter to the Division Office of Ozamiz City. After receiving clearance from the division office, permission will be sought from the School Principal of the public elementary school where the study will be conducted. Upon receiving approval from the Principal, letters will then be sent to the Grade Level Coordinator and the class Adviser to

secure their consent before proceeding with any data collection activities. Each letter will clearly outline the study's objectives, methodology, and scope to ensure transparency and adherence to institutional policies. Following the acquisition of institutional approvals, the researcher will distribute informed consent forms to the parents or guardians of the Grade 4 pupils, along with assent forms for the pupils themselves. These documents will provide detailed information about the study's purpose, procedures, benefits, and potential risks, ensuring that parents formally agree to their child's participation and that pupils voluntarily assent to participate.

The study followed a single pretest-posttest design over 6 weeks, consisting problem-solving tasks embedded within the SudoMath game. Data collection will be conducted over four sessions, each lasting approximately 60 minutes, spanning four weeks. Each session will begin with a pretest to assess the pupils' current numeracy skills, followed by gameplay and teacher-facilitated activities where pupils collaboratively engage in problem-solving tasks embedded within the SudoMath game. Each session will end with a posttest to evaluate immediate learning outcomes and skills gained.

In addition to these session-based assessments, a pre-intervention questionnaire assessing pupils' engagement and motivation will be administered before the first session to establish baseline data. Upon completion of the final session, a post-intervention questionnaire will be given to measure any changes in engagement and motivation. Mean scores from the pretests and posttests, along with data from the engagement and motivation questionnaires, will be analyzed to determine the effectiveness of the SudoMath approach in enhancing numeracy skills and pupil motivation. The use of standardized scoring rubrics

and validated instruments throughout the study will ensure consistent, reliable, and objective measurement of pupil progress and the impact of the intervention.

Ethical Considerations

Before conducting the study, the researcher will strictly observe all ethical standards to protect the participants' rights and welfare. Approval will be secured from the School Principal, Grade Level Coordinator, and class Adviser before any data collection begins, ensuring compliance with institutional and ethical guidelines. Informed consent will be obtained from parents or guardians of the selected Grade 4 pupils, and the pupils will provide their assent to confirm voluntary participation. Participants will be assured that they may withdraw at any time without consequences. Confidentiality and anonymity will be maintained by coding and securely storing all personal information. The study will also be designed to minimize any risk or discomfort, ensuring a safe and supportive environment throughout the process.

Data Analysis

This study utilized several statistical methods for data analysis with the aid of JAMOV software:

Frequency and percentage analyses were employed to examine the learners' level of mastery in numeracy skills before and after the implementation of the SudoMath game-based learning approach. These descriptive statistics helped in understanding the distribution and proportion of students across different mastery levels.

Mean and standard deviation were calculated both before and after the intervention. The mean scores represented the overall performance of the pupils, while the standard deviation provided insight into the consistency and variability of their responses.

A *paired sample t-test* was conducted to determine if there were significant differences in the learners' mastery and problem-solving skills before and after experiencing the SudoMath game-based learning approach. This inferential statistical test was used to evaluate the effectiveness of the intervention in enhancing students' numeracy abilities, analytical thinking, and application of mathematical concepts in practical contexts.

Dissemination Plan

The study's findings will be shared with school administrators, cooperating teachers, and the Grade 4 pupils and parents through reports, discussions, and simple summaries, ensuring they understand the benefits of the SudoMath Game-based Approach. Consent and assent procedures will be highlighted when sharing results with pupils and parents to emphasize ethical research practices. The findings will also be presented to the university community and other educators through seminars, presentations, and publications to support improved teaching strategies.

Utilization Plan

The results of the study will be used in various areas to improve teaching and learning practices. In the classroom, game-based activities will be applied at the end of each lesson to help pupils focus and retain concepts better. These strategies will also be shared with cooperating teachers during meetings or mentoring sessions to support their

professional development. Additionally, the findings will guide lesson planning, school improvement decisions, and future research aimed at strengthening pupil engagement and learning retention.

COST ESTIMATES

(Grade 4)

The estimated budget in the conduct of this study is broken down below from the personal money of the proponent. The proponent has a personal laptop and printer.

Materials	Amount
1 ream A4 US bond paper	Php 180.00
1 set 664 ink	Php 1,179.00
2 sliding folders	Php 15.00 x 2 (Php 30.00)
Tokens (ballpen)	Php 1, 000.00
Snacks	Php 1, 500.00
Total	Php 3, 889.00

RESULTS AND DISCUSSIONS

Level of Numeracy Skills of Grade 4 Pupils Before the Implementation of the Sudomath Game-Based Learning Approach

Table 1 presents the level of numeracy skills of Grade 4 pupils before the implementation of the Sudomath Game-Based Learning Approach. The findings revealed that the overall performance of the pupils was categorized as Did Not Meet Expectations, with an overall mean score of ($M = 27.73$, $SD = 2.08$). This finding indicates that the pupils had low mastery of numeracy skills prior to the implementation of the intervention, suggesting difficulties in understanding and applying basic mathematical concepts and operations.

Among the performance levels, the highest frequency was recorded under Did Not Meet Expectations with ($n = 36$, 85.7%) and a mean score of ($M = 14.9$, $SD = 4.568$). This was followed by the Satisfactory level with ($n = 4$, 9.5%) and ($M = 32.8$, $SD = 0.957$). Meanwhile, only ($n = 2$, 4.8%) of the pupils achieved the Very Satisfactory level, obtaining a mean score of ($M = 35.5$, $SD = 0.707$). Notably, no pupil reached the Outstanding and Fairly Satisfactory levels prior to the implementation of the intervention.

The findings indicate that the majority of Grade 4 pupils demonstrated low numeracy skills before the utilization of the Sudomath Game-Based Learning Approach. The dominance of pupils under the Did Not Meet Expectations category suggests that learners experienced considerable difficulty in understanding and applying basic mathematical concepts and operations. This may imply limited mastery of foundational numeracy competencies, which are essential for solving mathematical problems and

performing classroom tasks effectively. The very small proportion of pupils who attained Very Satisfactory and Satisfactory ratings further emphasizes the need for instructional interventions that can enhance learner engagement, motivation, and comprehension in mathematics. The relatively low overall mean also reflects that pupils may have been exposed to traditional teaching strategies that were insufficient in addressing diverse learning needs and promoting active participation during numeracy instruction.

Several studies support the finding that learners often demonstrate low numeracy skills prior to the implementation of game-based learning interventions. According to Hui and Mahmud (2023), game-based learning significantly enhances both cognitive and affective domains in mathematics, indicating that traditional instruction alone is often insufficient in developing numeracy skills. Similarly, Dan et al. (2024) found that primary learners frequently struggle with mathematical understanding when digital game-based strategies are not yet introduced, highlighting gaps in foundational numeracy development. Ergül and Doğan (2022) further emphasized that pupils taught through conventional methods in place value lessons showed limited engagement and understanding compared to those exposed to game-based learning. In addition, Rahayu et al. (2025) reported that digital game-based learning significantly improves students' numeracy literacy, suggesting that learners' low initial performance may be attributed to lack of interactive and meaningful instructional approaches. Overall, these studies highlight the necessity of innovative, game-based strategies to address numeracy difficulties among elementary learners.

The findings imply the need for teachers to use innovative and learner-centered strategies, such as the Sudomath Game-Based Learning Approach, to improve pupils'

numeracy skills. School administrators may support numeracy enhancement programs through training and instructional materials, while parents may assist learners through home-based activities and academic monitoring. Schools may also conduct remedial classes, peer tutoring, and mathematical games to address learning gaps and improve pupils' performance in mathematics.

Table 1

Level of Numeracy Skills of Grade 4 Pupils Before the Implementation of the Sudomath Game-Based Learning Approach

Performance	Frequency	Percentage	M	SD
Very Satisfactory	2	4.8	35.5	0.707
Satisfactory	4	9.5	32.8	0.957
Did Not Meet Expectations	36	85.7	14.9	4.568
Overall Performance	42	100.00	27.73	2.08

Note: 38-40 (Outstanding); 35-37 Very Satisfactory); 32-34 (Satisfactory); 29-31 (Fairly Satisfactory); 1-28 (Did Not Meet Expectations)

Table 2 presents the level of numeracy skills of Grade 4 pupils after the implementation of the Sudomath Game-Based Learning Approach. The findings revealed that the overall performance of the pupils improved to the Satisfactory level, with an overall mean score of ($M = 34.53$, $SD = 0.64$). The findings revealed that the overall performance of the pupils improved to the Satisfactory level, with an overall mean score of ($M = 34.53$, $SD = 0.64$). This finding indicates that the intervention helped improve pupils' numeracy skills, suggesting better understanding and application of mathematical concepts after the implementation of the Sudomath Game-Based Learning Approach.

Among the performance levels, the highest frequency was recorded under Outstanding with ($n = 14$, 33.3%) and a mean score of ($M = 39.3$, $SD = 0.83$). This was followed by Fairly Satisfactory with ($n = 13$, 31.0%) and $*(M = 30.2$, $SD = 0.44$). Meanwhile, ($n = 11$, 26.2%) of the pupils achieved the Satisfactory level with ($M = 33.1$, $SD = 0.70$), while the lowest frequency was observed under Very Satisfactory with ($n = 4$, 9.5%) and ($M = 35.5$, $SD = 0.58$). Notably, no pupil fell under the Did Not Meet Expectations category after the implementation of the intervention.

These results suggest that the Sudomath Game-Based Learning Approach contributed positively to the enhancement of pupils' numeracy skills. The absence of learners under the Did Not Meet Expectations category indicates that the intervention was effective in helping pupils attain at least the minimum expected level of mathematical competence. The increase in the number of pupils who reached the Outstanding level further implies that game-based learning may have strengthened pupils' engagement, participation, and understanding of mathematical concepts. The interactive and enjoyable nature of the Sudomath activities may have encouraged learners to actively solve problems, think critically, and practice mathematical operations with greater confidence. Moreover, the relatively low standard deviation across all performance levels indicates consistency in pupils' scores, suggesting that the intervention may have benefited not only high-performing learners but also those who previously struggled with numeracy skills.

Several studies support the positive effect of game-based learning in improving learners' numeracy skills, which aligns with the findings of this study. According to Sari et al. (2025), digital game-based learning significantly improves elementary students' numeracy literacy and engagement by making mathematical concepts more interactive and

meaningful. Similarly, Cayang and Ursabia (2024) found that the use of game-based learning strategies effectively enhances students' mathematical skills, particularly in problem-solving and conceptual understanding. Abbacan et al. (2025) also emphasized that educational games contribute to better numeracy skill development among elementary learners by increasing motivation and active participation in learning activities. In addition, Ferasol et al. (2024) reported that integrating game-based innovations in mathematics instruction leads to transformative improvements in learners' numeracy performance and classroom engagement. Overall, these studies confirm that game-based learning approaches, such as Sudomath, play a significant role in enhancing pupils' numeracy skills and academic achievement.

The findings suggest that teachers should continue using game-based and learner-centered strategies to improve pupils' numeracy skills and motivation in mathematics. School administrators and curriculum developers may support this through instructional resources, teacher training, and numeracy programs, while parents may reinforce learning through simple math activities at home. Schools may also provide remedial classes, cooperative learning activities, and numeracy drills to further enhance pupils' mathematical proficiency.

Table 2

Level of Numeracy Skills of Grade 4 Pupils After the Implementation of the Sudomath Game-Based Learning Approach

Performance	Frequency	Percentage	M	SD
Outstanding	14	33.3	39.3	0.83
Very Satisfactory	4	9.5	35.5	0.58
Satisfactory	11	26.2	33.1	0.7
Fairly Satisfactory	13	31.0	30.2	0.44
Overall Performance	42	100.00	34.53	0.64

Note: 38-40 (Outstanding); 35-37 Very Satisfactory); 32-34 (Satisfactory); 29-31 (Fairly Satisfactory); 1-28 (Did Not Meet Expectations)

Table 3 presents the significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the Sudomath Game-Based Learning Approach. The findings revealed a very highly significant difference in the numeracy skills of the pupils before and after the intervention, as indicated by the computed t-value and probability value ($t = 13.6$, $p = 0.001$). Since the obtained p-value was less than the 0.05 level of significance, the null hypothesis stating that there is no significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the Sudomath Game-Based Learning Approach was rejected. Furthermore, the mean score of the pupils increased from ($M = 17.5$, $SD = 7.91$) before the implementation to ($M = 34.5$, $SD = 3.83$) after the implementation, indicating a substantial improvement in pupils' numeracy performance.

The significant finding suggests that the Sudomath Game-Based Learning Approach had a positive and meaningful effect on the numeracy skills of Grade 4 pupils.

The notable increase in the mean scores after the intervention implies that pupils were able to better understand and apply mathematical concepts through interactive and engaging learning experiences. The game-based approach may have enhanced pupils' motivation, attention, and active participation during mathematics instruction, which contributed to improved academic performance. Moreover, the lower standard deviation after the implementation indicates that pupils' scores became more consistent, suggesting that the intervention benefited both low-performing and high-performing learners. This further implies that the Sudomath activities created an inclusive learning environment where pupils were encouraged to practice and strengthen their numeracy skills collaboratively and confidently.

No non-significant findings were observed in the study since the computed p-value ($p = 0.001$) was lower than the 0.05 level of significance. This indicates that all observed changes in the pupils' numeracy skills were statistically significant and were unlikely to have occurred by chance alone. The absence of non-significant results further strengthens the evidence supporting the effectiveness of the Sudomath Game-Based Learning Approach as an intervention in improving mathematics performance among Grade 4 pupils.

Several studies support the significant improvement in learners' numeracy skills after the implementation of game-based learning interventions. According to Hui and Mahmud (2023), game-based learning significantly enhances students' cognitive development in mathematics, leading to improved understanding and academic performance. Dan et al. (2024) also found that digital game-based learning in primary mathematics education produces statistically significant gains in learners' achievement,

reinforcing its effectiveness as an instructional strategy. Similarly, Ergül and Doğan (2022) reported that students exposed to game-based instruction in place value concepts performed significantly better compared to those taught using traditional methods. In addition, Rahayu et al. (2025) emphasized that digital game-based learning interventions lead to significant improvements in elementary pupils' numeracy literacy and overall mathematics performance. These findings collectively support the present study's result that Sudomath Game-Based Learning significantly improves Grade 4 pupils' numeracy skills.

The findings of the study have important implications for teachers, school administrators, curriculum planners, and parents. Teachers are encouraged to integrate game-based learning approaches such as Sudomath into mathematics instruction to promote learner engagement, critical thinking, and mastery of numeracy skills. School administrators may provide support through instructional materials, professional development seminars, and training programs focused on innovative teaching strategies in mathematics. Curriculum planners may consider incorporating more interactive and learner-centered activities into the mathematics curriculum to address learners' diverse needs and abilities. Parents may also reinforce learning at home by encouraging children to participate in educational games and numeracy-related activities. To sustain and further improve pupils' performance, schools may conduct regular numeracy enhancement programs, mathematics camps, peer tutoring sessions, and collaborative problem-solving activities that foster continuous learning and enjoyment in mathematics.

Table 3

Significant Difference in the Numeracy Skills of Grade 4 Pupils Before and After the Implementation of the Sudomath Game-Based Learning Approach

Performance	M	SD	T-value	P-value	Decision
Before the Implementation of the Sudomath Game-Based Learning Approach	17.5	7.91	13.6***	0.001	Reject H ₀₁
After the Implementation of the Sudomath Game-Based Learning Approach	34.5	3.83			

*Note: *** $p < 0.01$ (Very Highly Significant); ** $p < 0.01$ (Highly Significant); * $p < 0.05$ (Significant)*

H₀₁: There is no significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath game-based learning approach.

Chapter 4

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

Summary

This study aimed to determine the effect of the SudoMath Game-Based Learning Approach on the numeracy skills of Grade 4 pupils at a selected school in Ozamiz City during the School Year 2025–2026. Specifically, it examined the level of numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath Game-Based Learning Approach and the significant difference in the pupils' numeracy skills before and after the intervention. The study focused on Grade 4 pupils to determine how the use of SudoMath game-based activities influences pupils' understanding and application of mathematical concepts and operations.

Findings

This study yielded the following findings:

1. The level of numeracy skills of Grade 4 pupils before the implementation of the SudoMath Game-Based Learning Approach was categorized as Did Not Meet Expectations.
2. The level of numeracy skills of Grade 4 pupils after the implementation of the SudoMath Game-Based Learning Approach improved to the Satisfactory level.
3. There was a very highly significant difference in the numeracy skills of Grade 4 pupils before and after the implementation of the SudoMath Game-Based Learning Approach.

Conclusions

Based on the findings of the study, the following are the conclusions:

1. Grade 4 pupils demonstrate low numeracy skills before the implementation of the SudoMath Game-Based Learning Approach.
2. Grade 4 pupils demonstrate improved numeracy skills after the implementation of the SudoMath Game-Based Learning Approach.
3. The SudoMath Game-Based Learning Approach significantly improves the numeracy skills of Grade 4 pupils.

Recommendations

Based on the findings and conclusions of the study, it is recommended that:

1. Grade 4 Mathematics teachers integrate the SudoMath Game-Based Learning Approach and other learner-centered activities in classroom instruction to improve pupils' numeracy skills, engagement, and participation in Mathematics.
2. School administrators and school heads provide instructional materials, mathematical games, and teacher training programs that support the effective implementation of game-based learning approaches in Mathematics education.
3. Future researchers may conduct similar studies using larger samples, different grade levels, or other game-based learning strategies to further validate and expand the findings on the effectiveness of the SudoMath Game-Based Learning Approach in enhancing numeracy skills.

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Appendix A

SERVICE QUALITY QUESTIONNAIRE

Please read each statement carefully. This survey aims to understand your motivation, engagement and experiences in learning Mathematics through the SudoMath game-based approach. There are no right or wrong answers. Your honest responses will help improve teaching and learning in your mathematics class.

For each statement, put check mark that best describes how you feel: Please indicate the extent to which each statement applies to you by selecting the most appropriate response.

Use the following scale:

5 – Strongly Agree | 4 – Agree | 3 – Neutral | 2 – Disagree | 1 – Strongly Disagree

Constructs/Indicators	5	4	3	2	1
A. Interest in Math					
1. I enjoy learning new topics in mathematics.					
2. I am curious about numbers.					
3. Math activities make me excited to learn.					
4. I look forward to our Mathematics classes.					
5. I find math lessons interesting and challenging.					
B. Engagement During Activities					
6. I actively participate when the class uses the Sudomath game.					
7. I stay focused during Sudomath activities that involves games.					
8. I enjoy working with my classmates during game-based tasks.					
9. I feel more energized to learn when the activities are interactive.					
10. I feel motivated to finish my task when using suddomath.					
C. Motivation from Game-Based Learning					
11. Earning points or completing puzzles encourages me to do my best.					
12. Badges or rewards make me want to complete the tasks.					
13. I feel more confident in math using sudomath.					
14. I feel more to learn math when lessons include game challenges.					
15. Game-based activities make me feel accomplished as a learner.					

Constructs/Indicators	5	4	3	2	1
D. Self- Confidence in Mathematics					
16. I feel confident answering math problems during tasks.					
17. Game-based activities help me understand difficult math concepts.					
18. I feel more capable of learning math because of sudomath.					
19. I am not afraid to try challenging tasks during lessons.					
20. Game based approach helps me believe I can succeed in math.					
E. Perceived Learning Effectiveness					
21. I understand the lesson better when games are included.					
22. I remember lessons better when they are taught through games.					
23. Game-based activities help me learn math concepts more quickly.					
24. I feel that I learn more when I am engaged in game-based tasks.					
25. Sudomath game-based approach improves my overall performance in mathematics.					

Appendix B

Pre-test and Post-test (Math)

I. Directions: Choose the best answer. Write your answers in a separate sheet of paper.

1. What is the value of the digit 7 in the number 5,473?
a) 7
b) 70
c) 700
d) 7,000
2. What number comes next in the pattern? 2, 4, 6, 8, _____
a) 9
b) 10
c) 12
d) 14
3. $4,215 + 3,680 = ?$
a) 7,895
b) 8,895
c) 7,785
d) 8,785
4. Subtract: $9,000 - 4,567 = ?$
a) 4,333
b) 5,433
c) 5,533
d) 4,433
5. Multiply: $36 \times 5 = ?$
a) 180
b) 160
c) 150
d) 200
6. Divide: $144 \div 12 = ?$
a) 12
b) 11
c) 10
d) 13
7. Which of the following is a factor of 24?
a) 5
b) 6
c) 7
d) 9
8. Solve this word problem: Maria has ₱250. She buys a notebook for ₱75 and a pen for ₱30. How much money does she have left?
a) ₱145
b) ₱155
c) ₱165
d) ₱185

9. Find the missing number: 3, ___, 15, 20, 25
 - a) 6
 - b) 8
 - c) 10
 - d) 12
10. What is 25% of 200?
 - a) 25
 - b) 30
 - c) 40
 - d) 50
11. Which number is the greatest?
 - a) 0.75
 - b) 0.57
 - c) 0.705
 - d) 0.507
12. Round 6,548 to the nearest hundred.
 - a) 6,500
 - b) 6,600
 - c) 6,540
 - d) 6,550
13. What is the sum of the angles in a triangle?
 - a) 90°
 - b) 180°
 - c) 360°
 - d) 270°
14. Which of the following shapes has 4 equal sides and 4 right angles?
 - a) Rectangle
 - b) Rhombus
 - c) Square
 - d) Parallelogram
15. How many lines of symmetry does a rectangle have?
 - a) 1
 - b) 2
 - c) 3
 - d) 4
16. Which of the following numbers is a prime number?
 - a) 12
 - b) 17
 - c) 20
 - d) 21

17. What is the simple interest on ₱5,000 for 2 years at 5% per year?

- a) ₱500
- b) ₱250
- c) ₱1,000
- d) ₱750

18. Complete the sequence: 5, 10, 15, ____, 25, 30

- a) 18
- b) 20
- c) 22
- d) 24

19. Solve: $72 \div 8 + 5 \times 2 = ?$

- a) 26
- b) 22
- c) 19
- d) 16

20. What is the value of 3^3 (3 cubed)?

- a) 6
- b) 9
- c) 27
- d) 81

Appendix C

WEEK 1 LESSON PLAN (4As + Sudomath)

Grade: 4 | Time: 40 minutes

Topic: Identifying Place value concepts and recognizing number patterns

Teacher Activity	Pupil Activity
Preparation / Apperception “Good morning, class! How are you today?”	Good morning, Teacher! We are fine.
Look at this number: 4,726. Can you read it?”	Four thousand seven hundred twenty-six.”
Does each digit have the same value?”	No, teacher.
Motivation (Shows Sudomath puzzle with missing numbers) “Each correct answer completes the puzzle.”	Pupils listen attentively.
Today, we will learn about Identifying Place value concepts and recognizing number patterns	Pupils listen attentively.
ACTIVITY (Concrete Stage) “I will give each group problem and solve it.	Pupils listen attentively.
Group 1, look at 8,349 . What digit is in the thousands place?”	8
What is its value?	8000
Group 2, what is the value of 4 in 5,432 ?”	400
Why is it 400?”	Because it is in the hundreds place.”
ANALYSIS	
What happens if the digit moves to another place?”	Its value changes.”
Why is 6 in 6,215 worth more than 6 in 2,615?”	Because it is in the thousands place.”
What is place value?”	The value of a digit based on its position.
ABSTRACTION (Abstract Stage)	Pupils look at the board.
Name the place values up to 10,000.”	Ones, tens, hundreds, thousands.”
Why is it knowing the place value, important?	It is important so we can know how to read numbers.
APPLICATION “Now, answer on your paper. “Solve independently.	Pupils work quietly.
Find the value of 7 in 7,084 .”	7000
Find the value of 8 in 3,289 .	80
Find the value of 5 in 4,560 .	500
Generalization	

Teacher Activity	Pupil Activity
How do we know the value of a digit?"	By its place in the number.
Evaluation (Write the value of the underlined digit.)	
<u>6</u> ,482	6, 000
Closing "Very good, class! You did a great job today."	"Thank you, Teacher!"

WEEK 2 LESSON PLAN (4As + Sudomath)

Grade: 4 | Time: 40 minutes

Topic: Practicing addition and subtraction strategies with numbers up to 10,000

Teacher Activity	Pupil Activity
Preparation / Apperception "Good morning, class! How are you today?"	Good morning, Teacher! We are fine.
Who remembers place value?	We do, Teacher!
Why is place value important in addition and subtraction?"	So we can answer correctly.
Motivation (Shows Sudomath puzzle with missing sums) "Each correct answer completes the puzzle."	Pupils listen attentively.
Today, we will learn about Practicing addition and subtraction strategies with numbers up to 10,000	Pupils listen attentively.
ACTIVITY (Concrete Stage) "I will give each group problem and solve it.	Pupils listen attentively.
Solve this Sudomath box: $3,456 + 2,134$."	Pupils compute.
What is the first step?" what is the answer?	Add the ones
Next box: $8,000 - 2,475$."	5, 590
What strategy did you use?"	Regrouping
ANALYSIS	
Why do we regroup?"	When a digit is not enough.
How did sudomath you help you check your answer?"	The puzzle did not work if wrong.
Strategies make solving easier and faster."	Yes, teacher.
ABSTRACTION (Abstract Stage)	Pupils look at the board.
Addition combines numbers."	Pupils Listen.
Subtraction finds the difference."	Pupils,Listen
APPLICATION "Now, answer on your paper. "Solve independently.	Pupils work quietly.
$6,789 + 1,211 = ?$	8, 000

Teacher Activity	Pupil Activity
$9,432 - 3,218 = ?$	6, 214
$9300 + 400 = \underline{\hspace{2cm}}$	9, 700
Generalization	
When do we use regrouping?"	When needed in addition or subtraction."
Evaluation	
$9,500 - 2,500 = \underline{\hspace{2cm}}$	7, 000
Closing "Very good, class! You did a great job today."	"Thank you, Teacher!"

WEEK 3 LESSON PLAN (4As + Sudomath)

Grade: 4 | Time: 40 minutes

Topic: Solving multiplication and division problems using facts and strategies

Teacher Activity	Pupil Activity
Preparation / Apperception "Good morning, class! How are you today?"	Good morning, Teacher! We are fine.
Who remembers the multiplication tables?"	Yes, Teacher!
If $6 \times 4 = 24$, what is $24 \div 6$?"	4
Motivation (Shows Sudomath board with multiplication and division boxes)	Pupils listen attentively.
Today, we will learn about Solving multiplication and division problems using facts and strategies	Pupils listen attentively.
ACTIVITY (Concrete Stage) "I will give each group problem. Read the problem aloud."	Pupils listen attentively.
Form groups of four. Each group gets a Sudomath board."	Pupils form groups.
"Solve this box: 8×7 ."	56
Next box: $56 \div 8$."	7
Check if your answers fit the puzzle."	Pupils form groups.
ANALYSIS	
Why was it easy to solve $56 \div 8$?"	Because we know the multiplication fact."
What happens if one answer is wrong?"	Recall of facts."
What strategy did you use?"	he puzzle will not be completed
ABSTRACTION (Abstract Stage) (Writes on the board)	Pupils look at the board.
Multiplication and division are inverse operations."	Pupils Listen.
Does knowing facts helps us solve faster.	Yes, teacher.

Teacher Activity	Pupil Activity
APPLICATION “Now, answer on your paper. “Solve independently.	Pupils work quietly.
“ $9 \times 6 = \underline{\quad}$ ”	54
“ $72 \div 9 = \underline{\quad}$ ”	8
$10 \times 5 = \underline{\quad}$	50
Generalization	
How are multiplication and division related?”	They undo each other.
Evaluation	
If $5 \times 4 = 20$, what is $24 \div 8$?”	3
Closing “Very good, class! You did a great job today.”	“Thank you, Teacher!”

WEEK 4 LESSON PLAN (4As + Sudomath)

Grade: 4 | Time: 40 minutes

Topic: Solving One and Two-Step Word Problem Involving Four Operations

Teacher Activity	Pupil Activity
Preparation / Apperception “Good morning, class! How are you today?”	Good morning, Teacher! We are fine.
Do you experience having a math problem?	Yes, Teacher!
Do you think games can help us solve them?”	“Yes!”
Motivation (<i>Displays Sudomath Story Cards</i>) “Look at these. “Each card has a story problem you must solve to win.”	Pupils listen attentively.
Today, we will learn about Solving One and Two-Step Word Problem Involving Four Operations	Pupils listen attentively.
ACTIVITY (Concrete Stage) “I will give each group problem. Read the problem aloud.”	Pupils listen attentively.
Ana has 3,600 pesos. She buys a bag for 1,450 pesos. How much is left?”	Pupils think.
What are the given?	3,600 pesos and 1,450 pesos
What operation should we use?”	Subtraction
What is the answer?”	2,150 pesos
ANALYSIS	
“How did you find the missing numbers?”	We looked at the rule.”
Was the pattern increasing or decreasing?”	It depends on the rule.
“Very good! “The rule can be addition, subtraction, multiplication, or division.”	Pupils nod and listen.

Teacher Activity	Pupil Activity
ABSTRACTION (Abstract Stage) (<i>Writes on the board</i>)	Pupils look at the board.
Why did we subtract?"	Because money was spent."
Next problem needs two steps."	Pupils observe.
Ana has 400 pencils. She give 200 pencils. How many pencils are left?"	"We looked at the rule."
What is the answer?	200 pencils
APPLICATION "Now, answer on your paper. "Solve independently.	Pupils work quietly.
Mark has 2,500 pesos. He buys shoes for 1,200 pesos and a shirt for 650 pesos. How much money is left?"	
What is the answer?	650 pesos
Mark has 2,500 pesos. His mom gave him 3,230. How much money is there?	5, 730
Generalization	
How do we solve word problems?"	By understanding and choosing the right operations."
Evaluation	
John has 2,600 marbles. He gave 1,200 marbles to Joy. How many marbles are left?	1,400 marbles
Closing "Very good, class! You did a great job today."	"Thank you, Teacher!"

WEEK 5 LESSON PLAN (4As + Sudomath)

Grade: 4 | Time: 40 minutes

Topic: Identifying and Extending Numerical Sequences and Patterns.

Teacher Activity	Pupil Activity
Preparation / Apperception "Good morning, class! How are you today?"	Good morning, Teacher! We are fine.
Have you seen patterns in designs or clothes?	Yes, Teacher!
"Do numbers also have patterns?"	"Yes!"
Motivation (<i>Displays Sudomath Sequence Board</i>)"Look at these. "Each missing number follows a rule. Can you discover the rule?	Yes, teacher.
"Very good! Today, we will learn about Identifying and Extending Number Patterns and Sequences.	Pupils listen attentively.
ACTIVITY (Concrete Stage) "I will give each group problem and solve it"	Pupils listen attentively.

Teacher Activity	Pupil Activity
“Solve this Sudomath row: 5, 10, 15, __, __.”	Pupils solve the equation.
What did you add each time?	We add 5
Next pattern: 100, 90, 80, __.	Pupils solve the equation.
What did you subtract each time?	We subtract 10.
ANALYSIS (Pictorial Stage) (<i>Shows pictures of pattern</i>)	
“How did you find the missing numbers?”	We looked at the rule.”
Was the pattern increasing or decreasing?”	It depends on the rule.
“Very good! “The rule can be addition, subtraction, multiplication, or division.”	Pupils nod and listen.
ABSTRACTION (Abstract Stage) (<i>Writes on the board</i>)	
Why is identifying the rule important?	“So we know what comes next.”
A number pattern follows a rule.”	Pupils observe.
How did you find the missing numbers?”	“We looked at the rule.”
“The rule can be addition, subtraction, multiplication, or division.”	Pupils nod.
APPLICATION “Now, answer on your paper. “Complete the pattern.”	
2, 4, 8, 16, __”	32
3, 9, 18, 36, __	72
5, 10, 20, 40, __	80
Generalization	
How do we extend patterns?”	By following the rule.””
Evaluation “Which is the next term, 6, 12, 18 _____	24
Which is the next term, 7, 14, 21 _____	28
Closing “Very good, class! You did a great job today.”	“Thank you, Teacher!”

Appendix D

ACTION RESEARCH WORK PLAN AND TIMELINE (Grade 4)

Week	Focus / Activity	Procedure / Implementation
Week 1	Introduction & Pre-Assessment	- Introduce the day's lesson, Place value concepts and recognizing number patterns. - Explaining the SudoMath game and its purpose for improving numeracy. - Conducting pre-assessment to determine baseline skills.
Week 2	Guided Practice	- Introduce the day's lesson, Practicing addition and subtraction strategies with numbers up to 10,000. - Guiding pupils through SudoMath activities focused on these operations. - Conducting a quick reflection to assess understanding and focus. - Guide pupils through structured examples and exercises.
Week 3	Partner Practice	- Teach new content, Solving multiplication and division problems using facts and strategies. - Pupils work in pairs to apply what they have learned through collaborative exercises. - Exit Pass administered to reflect understanding, identify challenges, and encourage self-assessment.
Week 4	Reinforcement & Collaborative Work	- Teach new content, Solving one- and two-step word problems involving all four operations. - Pupils engage in small-group activities to practice and consolidate learning. - Facilitating group SudoMath challenges focused on problem solving. - Having pupils complete a wrap-up task to check comprehension.
Week 5	Independent Practice	- Teach new content, Identifying and extending numerical sequences and patterns. - Pupils independently playing SudoMath rounds emphasizing pattern recognition. - Using a closing exercise for pupils to summarize concepts and self-assess.
Week 6	Culminating Task & Post-Assessment	- Reviewing all topics through SudoMath activities. - Administering post-assessment to measure improvement. - Conducting lesson reflection to gather pupils' feedback.

Appendix E

PARENTAL CONSENT

Greetings!

I, a student researcher of _____ under the program of _____, respectfully request your permission for your child/children, who are under 18 years of age, to participate in our study.

This study aims to determine how the use of the **SudoMath Game-Based Approach** can enhance the **numeracy skills of Grade 4 pupils**. As part of this research, the participants will engage in SudoMath activities designed to develop their number recognition, logical thinking, and problem-solving skills in a fun and interactive way. These activities will help your child improve their mathematical understanding, strengthen their numeracy skills, and boost their confidence in learning Mathematics.

Your participation will be a great help for the success of our study.

Thank you very much!

Respectfully yours,

Researcher

Noted:

ACKNOWLEDGMENT

I have read this consent form and give my consent for my child/children to participate in this study.

Guardian's name: _____

Date: _____

Contact no.: _____

Signature: _____

Approved:

Name: _____

Ethics Review Board Chair

Contact no.: _____

PARENTAL CONSENT

Maayong Adlaw!

Ako, usa ka estudyante-researcher sa Misamis University ubos sa programa sa Bachelor in Elementary Education, mapailubon nga nangayo sa inyong pagtugot aron ang inyong anak/anak nga wala pa moabot sa 18 anyos moapil sa among pagtuon.

Ang pagtuon niini nagtinguha sa paghibalo kung giunsa paggamit og pagpauswag sa numeracy skills sa mga Grade 4 nga bata gamit ang SudoMath nga dula. Isip bahin sa pagtuon, ang mga bata magbuhat og SudoMath nga mga buluhaton aron mas mapraktis nila ang pag-ila og numero, paghunahuna, ug pagsulbad og problema. Kini makatabang sa imong anak nga mas masabtan ang Matematika, mapaayo ang ilang abilidad sa numero, ug mas modaghan ang ilang kumpiyansa sa pagkat-on. Kini sab nga kalihokan makatabang sa inyong anak sa pagpalambo sa iyang focus, partisipasyon, ug kahibalo sa leksyon, nga mosuporta sa mas maayong pagkat-on sa Mathematics.

Ang inyong pagtugot dako kaayong tabang alang sa kalampusan sa among pagtuon.

Daghang Salamat!

Respectfully yours,

Researcher

Noted:

ACKNOWLEDGMENT

Nasabtan nako kini nga porma ug naghatag ko og pagtugot nga moapil ang akong anak/anak sa pagtuon.

Ngalan sa Ginikanan: _____

Petsa: _____

Contact no.: _____

Pirma: _____

Giaprobahan:

Ngalan: _____

Ethics Review Board Chair

Contact no.: _____

Appendix F

KASABUTAN SA PAGTUGOT SA BATA

Ako, si _____, tibuok kasingkasing nga mosugot nga mahimong bahin sa pagtuon nga gitawag nga **“Enhancing the Numeracy Skills of Grade 4 Pupils Through SudoMath Game-Based Approach.”** Apil sa pamaagi ang pag-oberba sa akong partisipasyon sa klase ug ang paghimo og mga SudoMath nga dula o buluhaton aron masuta ang akong numeracy skills o abilidad sa numero. Walay bisan unsang peligro, sakit, o kadaot nga akong matagamtaman tungod niini. Ang tanan nga kalihokan buhaton sulod lamang sa oras sa klase ug dili molapas sa kasagaran nga buluhaton sa eskwelahan.

Wala ko gipugos, gikulbaan, o giingnan sa bisan unsang paagi aron moapil niini nga pagtuon.

Pirma sa Estudyante

Petsa

Saksi:

Ngalan ug Pirma sa Ginikanan

Petsa

ASSENT FORM

I, _____, willingly agree to take part in the study titled **“Enhancing the Numeracy Skills of Grade 4 Pupils Through the Use of Sudomath Game Based Approach.”** Part of the procedure includes observing my participation in class and using an exit pass to check my focus and how well I remember the lesson. This activity is safe and will not cause any harm or discomfort. This procedure will be done only during regular class hours and will not go beyond our usual school activities.

I understand that I am not forced, threatened, or pressured in any way to join this study.

Signature of Student

Date

Witness:

Name and Signature of Parent/Guardian

Date

Appendix G



Misamis University

Ozamiz City

MISAMIS UNIVERSITY RESEARCH CENTER

CERTIFIED: ISO 21001: 2018 Educational Organizations Management System by DNV
ACCREDITED: Philippine Association of Colleges and Universities Commission on Accreditation (PACUOCA)



MU-RC-042/13 November 2024

Thesis/Research Data Gathering Approval Form

Date: _____

Name of Authors: _____

College/Department: _____

Research Title: _____

Data Gathering Procedure:

a. Type of Research: (Kindly check)

☐

Quantitative

☐

Qualitative

☐

Experimental

☐

Approved Research Title
& Problem/Objectives

☐

Approved Data
Gathering Procedure

☐

Approved Data Gathering
Instrument/Data Sheets

b. Respondents/Participants/Subject/Samples to be Collected: _____

c. Procedure:

☐

Survey

☐

Interview

☐

Experimentation

☐

Laboratory Testing

d. Place of Implementation/Study Area: _____

If to be conducted outside the school campus, indicate the nature of transportation to be used:

☐

Own private vehicle

☐

public utility vehicle

☐

rental

☐

Others, please
indicate _____

e. Date/s of Implementation/Sampling: _____

Attachments:

☐

Approved Letter of Consent from the designated authority in the area/place where the study is to be conducted

☐

Signed Parents' Consent

The thesis proposal mentioned above is hereby recommended for the commencement of data gathering implementation.

Recommended by:

Thesis/Research Adviser

Thesis/Research Instructor

Approved by:

College Dean

CONTROLLED DOCUMENT

INFORMED CONSENT FORM

1. I volunteer to participate in the research undertaken by Joy Lyn C. Mutia from the College of Education, Misamis University. I understand that the research is designed to gather information about ENHANCING THE NUMERACY SKILLS OF GRADE 4 PUPILS THROUGH THE USE OF SUDOMATH GAME BASE APPROACH. I will be one of the participants who will be surveyed for this research.
2. My participation in this research is voluntary. I understand that I will not be paid for my participation. I may withdraw and discontinue participation at any time without penalty. If I decline to participate or withdraw from the study, no one will be told.
3. This research will involve my participation. I understand that most questions will find the discussion interesting and thought-provoking. If, however, I feel uncomfortable in any way during the survey session, I have the right to decline to answer any question or to end the survey.
4. The survey will last approximately 3-5 minutes.
5. I understand that the information to be gathered will be treated with confidentiality. I will not be identified in the paper. Only the researchers and their adviser will have access to the data of the research.
6. I understand that this research has been reviewed and approved by the DSAS Head of Misamis University.
7. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.
8. I have been given a copy of this consent form.

Participant's Signature

Date

For further information, please contact:

Joy Lyn C. Mutia (09106639818/ Casintojoy39@gmail.com)

CURRICULUM VITAE

PERSONAL DATA

Name : Joy Lyn C. Mutia
Date of Birth : November 12, 2000
Place of Birth : Purok-1, Bongbong Ozamiz City
Address : Purok-1, Bongbong Ozamiz City
Sex : Female
Civil Status : Single
Citizenship : Filipino
Religion : Kristohanon
Email Address : Casintojoy39@gmail.com



Educational Background

Tertiary Misamis University
Bachelor in Elementary Education- General
Feliciano St. Aguada, Ozamiz City, Misamis Occidental
(S.Y: 2022-2026)

Senior High La Salle University
Valconcia St. Aguada, Ozamiz City Misamis Occidental
(S.Y: 2018-2020)

Junior High La Salle University
Ledesma St. Aguad, Ozamiz City, Misamis Occidental
(S.Y: 2014 - 2018)

Primary Bongbong Elementary School
Purok-1, Bongbong Ozamiz City, Misamis Occidental
(S.Y: 2008 - 2014)



MISAMIS UNIVERSITY

Ozamiz City
College of Education



RESEARCH ROUTING FORM

Date: August 20, 2026

Name of Candidate: JOY LYN C. MUTIA

Sem./SY: 2nd Semester 2025-2026

Program: Bachelor of Elementary Education Major: General

Title of Research: Enhancing the Numeracy Skills of Grade-4 Pupils Through the Use of Sudomath Game Based Approach

	Signature	Date
Adviser: <u>Mrs. Julieta A. Macas</u>	<u>[Signature]</u>	<u>8-19-2026</u>
Program Head: <u>Beverly B. Dionio, MAEd</u>	<u>[Signature]</u>	<u>8-19-2026</u>
Chairman: <u>Genelyn R. Baluyos, EdD</u>	<u>[Signature]</u>	<u>8-19-2026</u>

Grammarly Result: 99/100

Approved for REPRODUCTION/PUBLICATION:

[Signature]
GENELYN R. BALUYOS, EdD
Dean, College of Education

MUTIA FINAL ACTION RESEARCH

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Sentence length **13.2**

 Above average

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